A CAHNERS PUBLICATION 156 TOTAL PAGES INTERNATIONAL EDITION / SEPTEMBER 1, 1990

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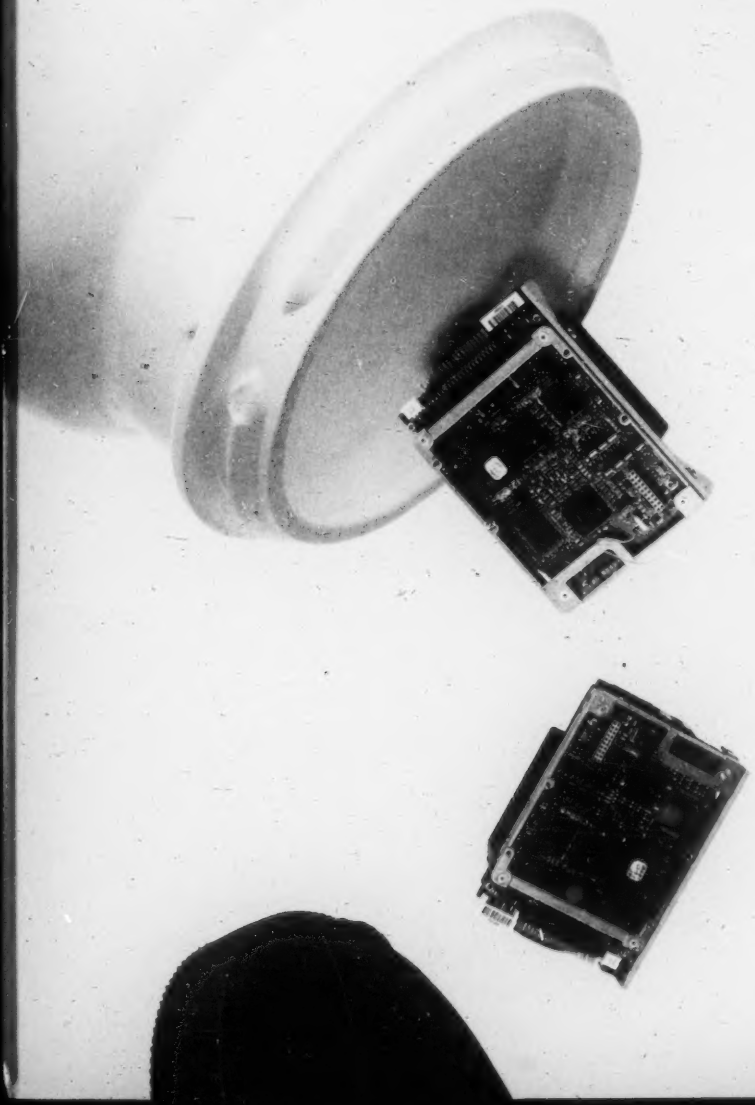
RELIEF FOR SLOW STORAGE SYSTEMS

Are You Suffering From Poor Disk Storage Performance? Relax! Help Is on the Way PAGE 22



Also in This Issue:

A Bold New Look for Word Processing PAGE 35

The Benchmark War in Transaction Processing PAGE 53

Living on the Fault LAN PAGE 77

Why IS Should Matter to CEOs PAGE 85

SEPTEMBER 1, 1990

DATAMATION

FOR MANAGERS OF INFORMATION TECHNOLOGY WORLDWIDE

VOLUME 36
NUMBER 17

COVER STORY

Berkeley's Katz could improve read performance dramatically with RAID Level Five.

Relief for Slow Storage Systems 22

BY JEFF MOAD To help disk subsystem performance keep up with ever speedier CPUs, some are turning to a new type of storage architecture—Redundant Arrays of Inexpensive Disks. But will the cure be worse than the problem?

Cover photography by David Bradley

SOFTWARE

GRAPHICS

A Bold New Look For Word Processing 35

BY RICK COOK Yesterday's users were happy with character-based word processing. But improved PC hardware, rising training costs and the need to share information among programs are fueling the switch toward graphics-based software.

DISTRIBUTED SYSTEMS

Serving Up Vertical Software 45

BY BOB FRANCIS Despite all the talk about client/server computing, few vertical market software packages have actually been shipped. But the selection is growing wider as more users rethink their future systems strategies.

INSIGHTS ON DISTRIBUTED COMPUTING

The aim is to off-load as much processing as possible to the intelligent desktop machines, leaving only the shared information and software for managing it at the server.

George Colony
Forrester Research Inc.
PAGE 45

Today, we have a world where the network itself attaches computing resources. Those resources may or may not be in the same location. They may be PCs, workstations or servers, and still others may be mainframes.

Howard Frank
Network Management Inc.
PAGE 69

We're trending toward LANs, and we're being asked to support mission critical applications on them.

Mike Carioscio
Kemper Financial Services Inc.
PAGE 77

DATAMATION
FOR MANAGERS OF INFORMATION TECHNOLOGY WORLDWIDE

SYSTEMS
OLTP

The Benchmark War in Transaction Processing 52

BY CHRIS SIVULA The latest volley in the battle to win on-line transaction-processing system orders comes from IBM. It's firing a shot across Tandem's bow, claiming to outperform the OLTP niche player.

MIDRANGE

Prime Users Still on Hold 61

BY CHRIS SIVULA A year ago, Prime Computer was battling a takeover and being wooed by a white knight. Now customers are demanding the company prove its financial stability and its commitment to IS.

SYSTEMS & STRATEGIES

COMMUNICATIONS
INTERVIEW

System Management Is Network Management 69

BY LEILA DAVIS A networking pioneer, Howard Frank gives his views on the changing nature of network management.

FAULT TOLERANCE

Living on the Fault LAN 77

BY SUSAN KERR Here's what you can do to build in some crash protection for LANs and a look at what's coming in disaster insurance from network vendors.

MANAGEMENT
LEADERSHIP

Why IS Should Matter to CEOs 85

BY TOM TINSLEY AND ANDREW C. POWER The leaders of world-class companies like Bankers Trust and Aetna are headed by CEOs who take information systems seriously, milking information technology for all it's worth.

MANAGEMENT
DISASTER RECOVERY

Oakland's Forced IS Lesson 93

BY CONNIE WINKLER When the walls came tumbling down, the San Francisco earthquake revealed a city computer system already in ruins from low budgets and few standards. A new centralized operation is rebuilding, the right way.

Oakland's corporate IS director Ferguson looks to rebuild a new centralized operation.

BUDGET POLICY

Managing Information Supply and Demand 99

BY RAYMOND T. HALL With IS budgets breaking $100 million in large companies, performance evaluation must move beyond planned-to-actual budget comparisons and examine the true value of information services.

INTERNATIONAL
JAPAN

U.S. Software Succeeds In Japan's Banks 103

BY MARSHA JOHNSTON Whether the banks are using it to improve customer service or to raise their capital ratios, one PC software import from New Jersey has helped to guarantee Japanese financial excellence.

Sanwa Bank's Suzuki found Futrak offered the best cost/performance for its applications.

EUROPE

Insurers Rewrite IS Policies 109

BY JOHN LAMB In the approaching wide open market, insurance giants see information technology as a vital means of beating their rivals to the punch with policy sales.

Special supplement, not included in all issues. 112-4

DEPARTMENTS

Inside DATAMATION	8	New Products	118	Career Opportunities	130
Letters and Access	12	Planner	128	Company Index	135
Look Ahead	17	Information Economics	129	Ad Index	136

A Solution to a Storage Problem

We've all heard about the virtues of multiprocessing and reduced instruction set computing. These advances in computing can provide users with productivity and performance gains. But these gains haven't come without costs. And one of the costs has been in the interplay between central processing units and disk storage subsystems.

The problem has been that RISC- or multiprocessing-based processing units are often not well matched to storage, leading to time lags between requests for data and availability. The bottom line, of course, is that computer power has not been used efficiently and effectively, an expensive waste of MIPS.

But as our cover story this issue, "Relief for Slow Storage Systems," page 22, shows, the spark of innovation is alive and well in the industry, and help is on the way. Says senior writer Jeff Moad, "Several leading systems vendors have embraced an approach that could help eliminate the expensive mismatch between CPU and disk subsystems. The idea is to redesign the subsystems: rather than basing them on large, expensive disk drives, as many now are, use arrays of many inexpensive 5¼-inch or smaller hard disks similar to those currently used in PCs and workstations. Proponents say a move to such so-called redundant arrays of inexpensive disks (RAID) could significantly improve disk subsystem performance and revolutionize data availability."

TAKE TWO and storage in the morning

Already, prestigious companies such as Compaq Computer Corp., Control Data Corp., Data General Corp., IBM, Memorex Telex Corp., Storage Technology Corp. and Tandem Computers Inc. have started development on RAID technology or have actually announced plans to ship an array design. Even though actual, usable products may be a ways off in most cases, a technological solution to the problem of poor disk storage performance is coming.

RAID takes up less space and power than do larger disk systems, and have the potential for what Moad calls fault-tolerant data storage and for increased data transmission rates, among other advantages.

All in all, RAID technology may be the solution for an important class of storage problems. It's now up to the companies developing this technology to follow through, test their approaches with users and provide viable products to the market.

Of Client/Server Software

The rubber meets the road at the applications level. If the right software doesn't exist, then the job, however well-intentioned the hardware, can't be done. This is particularly true in so-called client/server computing, where the available applications software has not caught up to the capability of existing hardware.

But there is some evidence now that the applications shelves are starting to be stocked. As our Dallas-based PC writer, Bob Francis, says in "Serving Up Vertical Software," page 45, small vertical applications software companies that had been teetering on the cutting edge have found their balance, providing products that may challenge their big-system forerunners in focused markets such as accounting, banking and manufacturing.

That's good news for companies trying to distribute their computing resources. So tune in to Francis' article to find out what may be in store for you.

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Serving Up Vertical Software

Despite all the talk about client/server computing, few vertical market software packages have actually been shipped. But the selection is growing wider as more users rethink their future systems strategies.

BY BOB FRANCIS

Consider it the computer industry's version of *The Never Ending Story*. Just as software lagged behind hardware in the mainframe and minicomputer worlds, applications are now hard to find for today's client/server hardware. A few general purpose database packages are available, but the selection of vertical software, targeted at the needs of specific industries, is practically nonexistent.

Demand for such applications is growing, however, causing a number of vendors to focus on vertical markets such as accounting, banking and manufacturing.

"These companies have sprung up much faster than we had expected, and they've begun to be recognized," says David Kaplan, product manager for Redmond, Wash.-based Microsoft Corp.'s SQL Server. According to Kaplan, many of the client/server software pioneers are successfully selling vertical market products, even though some of the elements of client/server computing are yet to be set in cement.

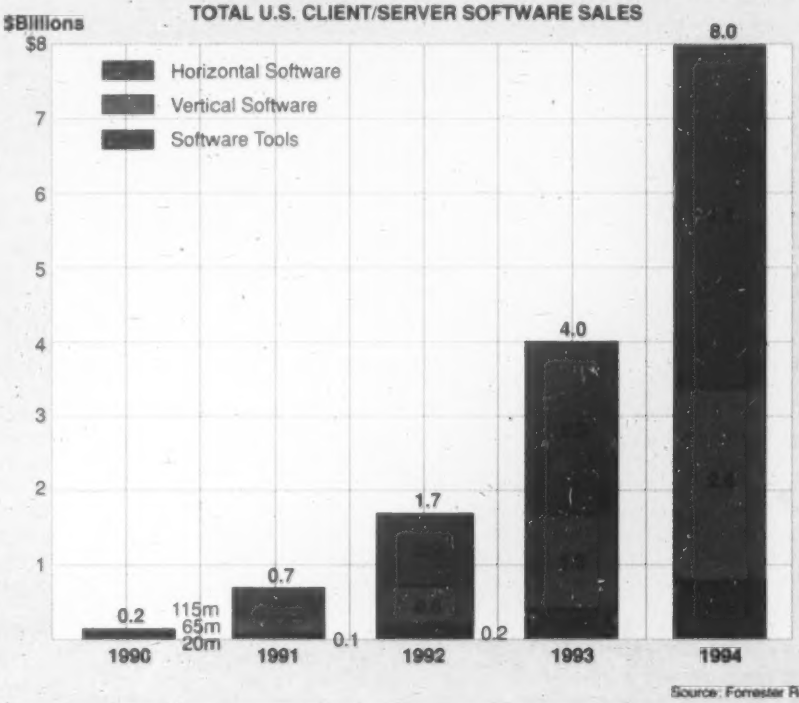
Off the Edge

A year ago, many client/server software providers were considered so far out on the cutting edge that they threatened to fall off. But, today, these same companies are not meeting the resistance they once did from customers seeking more conventional, mainframe-based applications. "We've seen a change in the last six months. The RFPs [requests for proposals] coming out now are saying they prefer an SQL engine and a graphical user interface. . . . It's not 100% of them yet, but there's more of them now than there were just a year ago," says David Duffield, president of PeopleSoft Inc. of Walnut Creek, Calif.

A survey of IS managers done for DATAMATION by the Wall Street investment firm Cowan & Co. confirms this shift toward distributed computing. In the survey, respondents said they were targeting desktop PCs and workstations for a greater percentage of their applications development budget. Survey results show that 18% of new applications will be implemented on PCs and workstations through 1991, while 64% will be run on mainframes and 18% on minicomputers. For the longer term, PCs and

Big Bucks for the Software Business

Horizontal software packages lead the market overall, but vertical products will still constitute a billion-dollar market by 1993.



workstations will garner 27% of future development work. As this trend takes hold, it will allow software companies focused on the vertical client/server market to start small and grow as businesses implement the model companywide.

Flexibility Counts

Still, despite the tilt toward distributed platforms, the Cowan survey indicates the mainframe is far from dead, and the move to client/server computing will not be instantaneous. Consequently, many of the vertical software companies are creating products that can adapt to various computing models.

PeopleSoft's human resource management software is an example of the flexible approach that some providers are taking as the transition to client/server systems takes hold. Its software can run with IBM's DB2 mainframe system, as a New York state database of 1.2 million persons demonstrates. But it can also go on a stand-alone workstation running Microsoft's Windows or OS/2. "That's part of the beauty of it and, in addition, it gives us a much larger sales target," says PeopleSoft's Duffield. "We're not limited to companies that have implemented client/server computing throughout their organization. We can come in on a workstation and later add DB2 capabilities."

What Some Early Birds Want

While an evolutionary transition will make sense to many potential users, a few companies are jumping headfirst into client/server computing as they seek to cut

□ THE MOVE TOWARD CLIENT/SERVER COMPUTING WILL NOT BE INSTANTANEOUS.

costs and deflate bloated management structures. Eastman Kodak Co., in Rochester, N.Y., is one of those. It's struggling to transform itself into a swiftly moving global company and has bet heavily on client/server computing to get there.

When Kodak first embraced client/server computing in 1988, few packaged software products were available. Today the film company uses PeopleSoft's human resources software in some locations and is also a large user of a client/server MRP II manufacturing offering from Fourth Shift Corp., a manufacturing software company based in Minneapolis.

Implementing the MRP II package hasn't all been easy, but not for technical reasons. "It's been more a question of culture change and less a question of technological change," explains Jack Philben, Kodak's manager of decentralized manufacturing support systems.

According to Les Hellenack, an analyst at International Data Corp. in Framingham, Mass., cultural challenges will eventually overshadow today's more technical concerns. "Kodak really broke some ground when they began implementing this system at their manufacturing plants. Basically, their local plant managers are now more responsible for a plant's performance than they were when data processing was handled centrally. That meant some real changes in the way these plants operated, and that's going to happen wherever this model of computing is implemented," Hellenack warns.

Taking Client/Server to the Bank

An industry where client/server systems are just beginning to stir is banking, possibly a natural market for decentralizing computing technologies in view of the inherently distributed nature of branch banking operations. Several software vendors are pushing client/server computing in this area and regard branch banks as their ticket to success. Banking automation vendors such as NCR Corp. are committed to the client/server model across their entire product line, according to Henry McClain, NCR's director of branch automation systems.

Nevis Technologies Inc., a two-year-old Culver City, Calif.-based software company, also hopes to cash in on the banking market. Nevis recently delivered a pilot version of its Nevisys package, which allows banks to customize retail branch banking application, to two original equipment manufacturer customers: Nixdorf Computer AG and Wang Laboratories Inc. Both OEMs will bundle Nevisys, which bases its networked PC technology on Microsoft's OS/2 LAN Manager, with their own server hardware and networking systems, says Richard B. Ghastin, Nevis' chief financial officer.

Ghastin admits that in banking, as well as in other sensitive applications of client/server computing, security will be a key priority. "That's obviously a big issue for banks, but the technology is going to be there to solve that problem," he predicts. Ghastin expects that future storage systems and agreements among vendors to establish standards will specifically address security issues.

In Search of Tools

Despite growing customer interest in vertical applications, even the most ardent supporters of client/server comput-

What Qualifies as Client/Server, Anyway?

Any discussion of client/server computing would be incomplete without a definition of the model. While many people have their own interpretations, most experts agree that client/server computing splits the processing of an application between a front-end portion executing on a PC or workstation and a back-end portion running on a server. The front end typically handles local data manipulation and maintains the user interface, and the back end handles database and other number-intensive processing.

"The aim is to off-load as much processing as possible to the intelligent desktop machines, leaving only the shared information and software for managing it at the server," says George Colony, president of Forrester Research Inc. "The client fulfills users' need for independence, computing power and a user friendly interface, while the server fulfills the corporation's requirements for cohesion, making certain information is backed up and databases are synchronized, protected and secure."

According to Colony, most client/server systems are designed for PCs and LAN-based operating systems or for UNIX-based servers and workstations. By 1992, Colony predicts that on the server side, 60% of client/server operating systems will be based on OS/2; 30% will be running UNIX; and the remaining 10% will run Digital Equipment Corp.'s VMS, IBM's MVS, or other proprietary operating systems.

Landmark Graphics Corp., a Houston-based computer-aided exploration company, counts itself in the UNIX camp. It uses IBM and Sun workstations to deliver computer-aided exploration software to oil companies. According to Landmark's president, C.E. "Gene" Ennis, Landmark's client/server approach is beginning to pay off. "More and more oil companies are beginning to standardize on this architecture for their new purchases. When we started [in 1985] we were really kind of out on a limb."

ing admit that not all the elements are in place to make it a major industry force. Terry Peterson, vice president for field support services at Fourth Shift, for example, is waiting for the same quality of development tools that he remembers from his mainframe background. "We still need better LAN diagnostic tools," he says. "And we need some platform enhancements—network managers to database managers—combined with the new server technology to transform current client/server implementations into on-line transaction-processing engines."

Technology is being developed to resolve some of those issues, says Mike Clark, director of systems engineering at Houston-based Compaq Computer Corp. "Our agreement with Novell is one effort aimed at that end for the SystemPro and other client/server computing architectures," Clark says. This agreement calls for Novell Inc. and Compaq to develop fault tolerant LAN functions, putting client/server systems more directly in competition with mainframes and minicomputers for vertical applications like on-line transaction processing (see "Living on the Fault LAN," p. 77). Results from the agreement are expected by late 1991 or early 1992.

Enter the Minicomputer Makers

Like Fourth Shift's Peterson, who describes his own sudden and complete conversion from the mainframe world to the client/server community as a "Saul to Damascus" experience, the client/server model is rapidly finding converts among traditional minicomputer suppliers. Fourth Shift has signed a distribution agreement with Data General Corp. which will port Fourth Shift's products to its UNIX software platform, AViiON. Eventually, Fourth Shift will port its products to the client side of OS/2. "The real benefits of OS/2 and UNIX, over and above our current DOS implementation, is the concurrent . . . processing that it will provide," says Peterson.

> ☐ **IT'S BEEN MORE A CULTURE CHANGE AND LESS A TECHNOLOGICAL CHANGE.**

Meanwhile, Hewlett-Packard recently signed an agreement with PeopleSoft, which also happens to be an IBM business partner, demonstrating that IBM also has its eye on the technology.

Although the blossoming of client/server computing is sure to invite a flood of software competitors, the early entrants feel confident in their lead. Says PeopleSoft's Duffield: "We think we have a good two- to three-year head start before the competition begins to catch up." Nevertheless, the competitors are on the horizon. One of Fourth Shift's primary competitors, for example, is ASK Computer Systems Inc., a Mountain View, Calif., software supplier that started in the minicomputer business and is shifting its development toward more distributed computers and databases.

According to George Colony, president of Forrester Research Inc. in Cambridge, Mass., many such mainframe and minicomputer companies are beginning to see the light. "ASK moved pretty quickly, and others are going to follow," says Colony. ▭

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Living on the Fault LAN

Here's what you can do today to build in some measure of crash protection for LANs and a look at what's coming in disaster insurance from leading network vendors.

BY SUSAN KERR

When a local area network (LAN) crashes, the consequences of data loss and lost work time can be intolerable. That's why a growing chorus of IS managers are demanding more fault tolerance from LANs.

A study of 100 IS and network managers at *Fortune* 1,000 companies completed last year by Santa Clara-based Infonetics Inc. for communications test equipment vendor Network General Corp. of Menlo Park, Calif., found that LAN downtime in large companies causes average yearly revenue losses of $606,000 and employee productivity losses of $3.48 million. It also found that the average network is disabled 6% of the time.

Nothing on the horizon will put LANs in the same fault-tolerant league as one of Tandem Computers Inc.'s mainframe systems, but uninterruptible power supplies (UPSs), disk mirroring and disk duplexing can make LANs less vulnerable today. Both Novell Inc., which already has some fault-tolerant features in NetWare network operating system, and Microsoft Corp. will be improving this aspect of their network software in future releases.

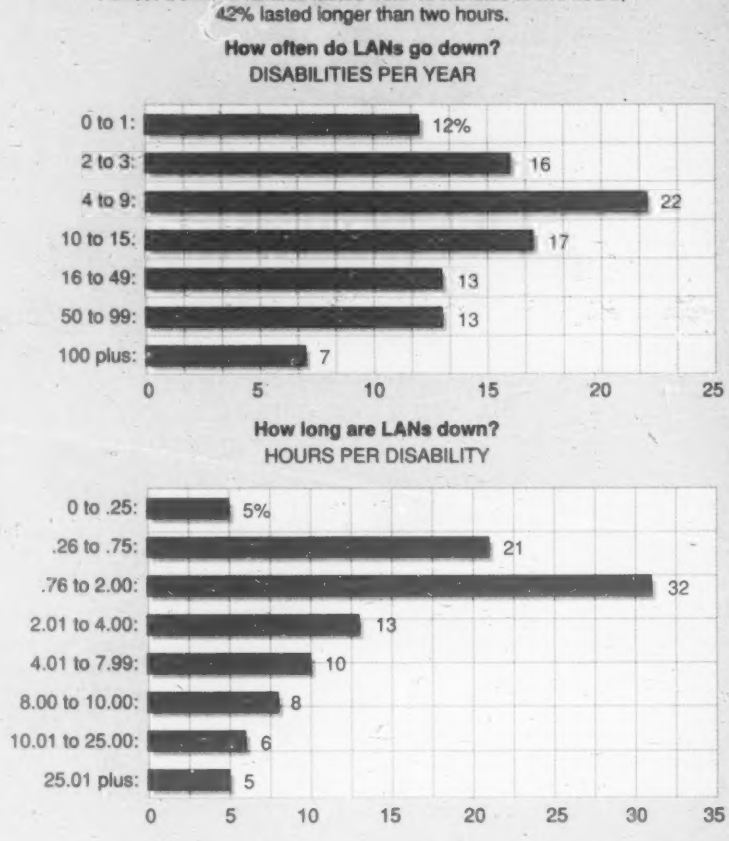
"We have asked for this," says Jawaid Ekram, manager of systems engineering for Chicago-headquartered Covia Partnership. His organization provides the Apollo computer reservation system for United Airlines Inc. and is a major supporter of token ring networks and Microsoft's LAN Manager. Covia currently depends on home-grown safety features, but Ekram wants more products out on the market so that he can store more data locally at airports and travel agencies rather than on central corporate host computers. "Microsoft is doing this [fault tolerance] under pressure," he adds.

That pressure is being felt by many

Illustration by Chuck Morris

Why IS Managers Want Fault Tolerance

A study of 100 LAN users reveals that most experience 10 or more LAN failures yearly. Almost a third of failures lasted from 45 minutes to two hours; 42% lasted longer than two hours.



Source: Infonetics Inc.

LAN vendors, including IBM. Although Big Blue currently has no fault-tolerant products, it will when it completes the merger between its OS/2-based LAN Server and Microsoft's LAN Manager. Fault tolerance is one of the biggest requests IBM gets from LAN customers, says Alastai: Watson, IBM LAN systems architect based in Austin, Texas.

Microsoft's most recent offering, LAN Manager version 2.0, features the company's first attempts at fault tolerance, meaning that the product's resellers (including Digital Equipment Corp., 3Com Corp. and Ungermann-Bass Inc.) also will be endorsing the concept. Novell, which offers the System Fault Tolerance (SFT) NetWare operating system for 80286-based servers and networks, now is making those features standard in its NetWare 386 3.0 platform.

Protecting the Server

As applied to LANs, the term *fault tolerance* is misleading, says John Erlandson, product marketing manager at Ungermann-Bass, which is now part of Tandem. Mindful of his parent company's business, Erlandson feels more comfortable describing what the LAN vendors do as "building redundancy" into the network rather than guaranteeing that no matter what happens, no data will be lost.

This redundancy is designed to overcome known weaknesses in networks. David Thacher, senior product manager for Microsoft's network business unit says the three most common problems in a server-based environment are power outages, disk drive failures and drive controller board failures. Users seem to have the same list of complaints.

Uninterruptible power supplies can take care of the power issue. Disk mirroring and disk duplexing can do the same with disk drives and controllers. Disk mirroring means the server contains duplicate disks, and all information is written to both simultaneously. Disk duplexing means that the controller is duplicated.

Even if you have no need for these features, it's always smart to think ahead about what you'll do when the server goes down.

Good backup procedures are No. 1 on the list so that, if the network goes down, only a limited amount of work will be lost. United Airlines' corporate staff, for example, performs daily backups. Also standard at United is the practice of having spare PCs or servers ready to be used at a moment's notice.

Good network design can also serve as a safeguard, whether it means placing servers in protected, out of the way areas or making sure cables are not out and about where users can roll their chairs over them. Likewise, network design also includes designing your backbone so that if one link goes down the network can reroute over another link.

Although some might add human error as a cause of concern, most vendors say that they are limited in what they can do on that score. It's up to users to have good security and backup procedures in place. Thacher says, "You can only protect against pilot error to some extent. If the pilot aims the plane to the ground, it'll crash. It's the same scenario with a network administrator."

> ☐ **WE DON'T WANT TO PROMOTE SERVER MIRRORING. WE WANT RELIABLE SERVERS.**

The minimal level of server protection may appear to be relatively easy to provide, but in practice it has proved difficult. Disk mirroring, for example, has been less than satisfactory.

At Kemper Financial Services Inc. in Chicago, PC research analyst and consultant Chris Harnack recalls some problems his company had with Novell SFT software and disk mirroring. "The one time a disk failed, mirroring didn't help," he says. "It mirrored the failure into the other disk, wrote something incorrectly, and then the system wouldn't boot."

Mirror, Mirror on the Net

Novell's 286 SFT NetWare is known to have bugs, including problems in remirroring disk drives larger than 250 megabytes. Reportedly, 386 NetWare addressed these issues. Time will only tell what success Microsoft will have in avoiding major problems.

Many users prefer an alternative in fault tolerance. The most common request is for server mirroring, in which there are duplicate servers. Users feel this would offer greater protection since the potential for failure is not concentrated in a single box.

But this technology is a touchy subject

for the major LAN vendors. Microsoft is not even attempting to deal with the issue of server mirroring right now, calling the approach expensive and not very efficient. But some users, like Covia, expect that the software company will have little choice in the matter.

Novell has long talked about server mirroring but has yet to deliver. Now it says it will not offer server mirroring for its 286 server but promises to make it available for 386 users in 1991.

3Com also has been bitten by server mirroring, having announced it in March 1988. The company that was developing it, Atlantic Microsystems Inc. of Salem, N.H., is no longer around, and the idea has been dropped by 3Com. As a development partner of Microsoft's, 3Com will instead push what is in LAN Manager.

Microsoft's Thacher doesn't like mirroring at all. What he would prefer to see instead is improved database technology where a database is stored across the network on different servers and kept current.

Obviously, keeping two—or even more—servers synchronized is a tough job. One way vendors try to get around the issue is to maintain that their products are so reliable there is little need for server mirroring.

"We don't want to promote server mirroring since we want to promote reliable servers," says Jim Lima, a 3Com product manager. His fellow product manager, Frank Howley, adds that the mean time between failures for the latest generation of 3Com servers is greater than eight years. Thus, he says, hardware has gotten remarkably reliable.

This is certainly the argument repeated by Digital's Ethernet LAN product marketing manager Stephen Allen. "For the majority, it's like wearing a belt and suspenders at the same time," he says. "It [fault tolerance] could be overkill."

A Difference of Opinion

Maybe. But a growing base of network users seem to want that "overkill." And their demands are becoming more urgent as they transfer some of their dependence from large systems to PC LANs.

"We're trending toward LANs, and we're being asked to support mission critical applications on them," says Mike Carioscio, director of corporate automation for Kemper. "There's a gap here. You have all this good stuff on minis and mainframes, but it is not all there on PC LANs."

Adding to five stand-alone LANs already in place, the financial services company installed a token ring LAN this summer. This new network supports a new application that provides financial sales information to 100 Kemper representatives taking calls from brokers. "If that link goes down, we start losing money," says Carioscio. As a result, Kemper is seeking better fault tolerance by moving to NetWare 3.0.

The burden associated with downtime is related more closely to the nature of a company's applications than to the extent of its systems. The Hospital of the Good Samaritan in Los Angeles, for example, runs six small LANs under SFT NetWare, according to PC coordinator Joey Hayashi. Legally, the hospital must maintain (thus protect) certain records, leading to the decision in favor of fault tolerance.

On the other end of the spectrum, at United Airlines' corporate computer organization, information services manager Richard Sowiak is moving his much larger organization cautiously toward fault tolerance. "Our computing is not operationally critical to the running of the airline or the making of real-time decisions," he explains.

Still, on a 1 to 10 scale of importance, he ranks fault tolerance as a 7. His 400-person application development team depends on 12 token ring networks. If one of the file servers goes down, that could idle 30 programmers in one fell swoop. Thus, Sowiak is thinking of switching from his current IBM PS/2 model 80 servers to those from NetFRAME Systems Inc., which feature multiple CPUs.

Sowiak's organization currently protects itself by keeping spare equipment, which can be swapped in the event of a failure. Although problems have been relatively rare, Sowiak says, the advent of distributed computing in his organization will make him less tolerant of even the potential for disturbances.

Sowiak is not alone.

"If you're looking at a work group environment, disk mirroring will take care of the vast majority of problems," says Matthew Woods, owner of ComputerEase, a Long Beach, Calif., company that designs networks for users. "But," he adds, "with the current trend of moving more and more corporate data onto PC networks from minis or mainframes, then you have a critical need for more safeguards."

LAN Safety Checklist

These procedures can head off disastrous data losses in the event of a LAN failure:

- Design the backbone network to allow rerouting when one link goes down.
- Use uninterruptible power supplies on the server and even on individual workstations involved in critical processes.
- Physically isolate servers and cables so that people and furniture can't bump into them.
- Use disk mirroring or duplexing for server disk drives.
- Double cable for greater protection of critical links.
- Back up frequently!

NetWare vs. LAN Manager: Fault Tolerance

Fault tolerance is fertile ground for the continuing battle between Microsoft Corp.'s LAN Manager and Novell Inc.'s NetWare software.

Standard on NetWare 386 version 3.0 are features previously available in Novell's 80286-based SFT NetWare. These include disk mirroring, disk duplexing and a uninterruptible power supply (UPS) monitoring facility. New and only available for NetWare 386 (although previously announced but never delivered for the older system) is server mirroring. All NetWare software contains a "hot fix" ability, which means that if a problem is detected on a piece of disk media, the data is remapped to a predefined, presumably safer, section of the same disk.

While Novell has had the lead in fault tolerance, LAN Manager is picking up on many of the same features. Fault tolerance was not offered in previous versions of LAN Manager; it has been added to LAN Manager 2.0, which became available this summer.

Microsoft has added hot fix, disk mirroring, disk duplexing and UPS support. In addition, it has one feature not available in NetWare called the Replicator. This allows an administrator to designate files on a server that will then be copied automatically to another server. This differs from server mirroring in that the whole disk is not being copied and the file must be closed before being replicated. Thus, it is not synchronous and not a true fault-tolerance measure, but it could come in handy.

Insurers Rewrite IS Policies

In the approaching wide open market, insurance giants see information technology as a vital means of beating their rivals to the punch with policy sales.

BY JOHN LAMB

The fragmented European insurance industry is getting its act together.

The past two years have brought an avalanche of mergers, alliances and overseas ventures as the 4,000 companies that compose the European industry struggle to get in shape for the post-1992 unified market and brace for the stiffer competition that will ensue in the race to secure the business of 325 million consumers.

As the wheeling and dealing intensifies, information technology (IT) is emerging as a key element in the game plans of insurance industry executives. "I believe that the use of information technology will increasingly play a crucial role in enabling our underwriters and brokers to exploit the many opportunities that will undoubtedly present themselves," says Murray Lawrence, chairman of the historic Lloyds of London.

Others maintain that successful exploitation of information systems is already a deciding factor in the industry. "Up until two years ago, few companies had a business strategy that linked with IT; most companies had fairly reactive strategies. Now you can't tell the difference between business and IT strategies," says Jeff Watkins, a researcher in management studies at Bristol University in Britain, who has just completed a study of the use of IS in the British insurance industry.

Watkins maintains that up until now some of the most successful insurance companies have had miserably inadequate IS strategies, with computer power being confined to administrative tasks. That is changing, he claims, as some companies begin to invest heavily in "competitive edge" systems. These systems often link salespeople's portable PCs to client databases or deliver comparative information about a variety of insurance policies from a number of companies via electronic data interchange (EDI) networks. "Over the next three to four years, we will see a division between leading edge companies and those who have lagged on technology," he says.

PRUDENTIAL'S MORRIS: For the insurance industry, 1992 is a concept, not a date

Big Bucks for IS

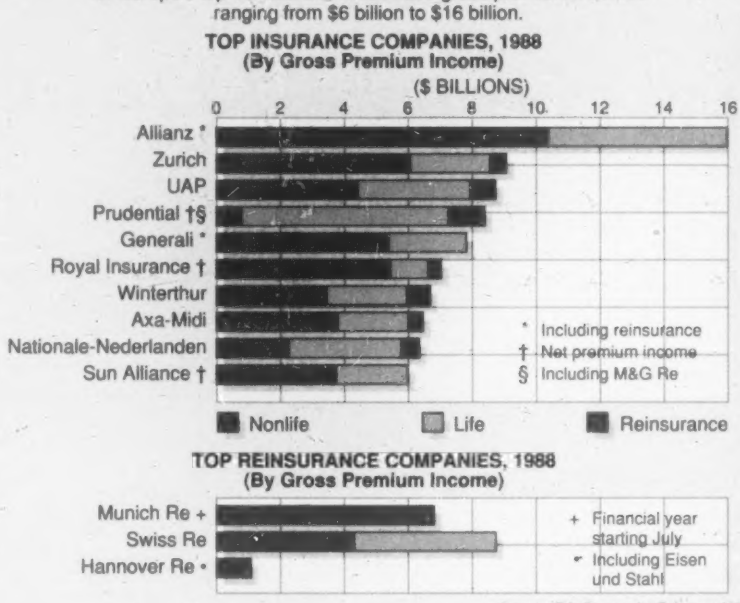
The cost of entering the technology is not cheap. One network, based in Brussels, Belgium, the European Reinsurance and Insurance Network (RINET), which delivers an EDI service across the Continent, charges a one-time membership fee that works out to around $425,000 per company. But major players in the insurance industry have deep pockets. IS spending in those companies is currently running at around 2% of their annual gross premium income, Watkins estimates. That gross income ranges within Europe's top 10 from the $6 billion at the U.K.'s Sun Alliance up to the $16 billion at West Germany's Allianz.

Some companies whose pockets are not quite that deep are merging with other insurance industry players to give themselves greater IS investment clout. "Companies are launching takeover bids like fury as [investing in] IT becomes increasingly important in selling policies," says Bob Carter, professor of insurance at Nottingham University in Britain.

No one can afford to take any chances when it comes to meeting the challenge of pan-European marketing and administration. The European Commission is beginning to create a single insurance market in Europe out of the wildly

The Giants of Europe

Financing new insurance administration systems should pose little problem for Europe's top 10 insurers, which have gross premium incomes ranging from $6 billion to $16 billion.



Source: *The Economist*, February 1990

differing national markets. This involves sweeping away the regulatory cobwebs in each country that snare foreign insurance companies. So far, for example, the commission has eliminated prohibitions on European insurance companies wishing to set up branches in neighboring countries. The next step for the commission is to make it possible for companies to trade across borders without necessarily having offices in both countries.

The commission is also trying to step up the pace of IS innovation aimed at contributing to a pan-European insurance market. As part of its Research in Advanced Communications in Europe (RACE) program, the commission is paying for the development of a standard electronic case-handling system. The RACE project involves six collaborators, headed by Philips International, a Dutch insurance company. The partners are working on a system that will support 10 to 15 insurance employees working on distributed workstations via broadband fiber optic cable. The workstations, equipped with graphical user interfaces displayed on high-definition monitors, will deliver data, images and voice relating to all aspects of insurance policy administration over Internet and Fiber Distributed Data Interface (FDDI) local area networks. Custom-built software for the project will facilitate program-to-program communications and provide procedures and guidelines that will help case workers handle their files more effectively.

□ ONE INSURANCE EDI NETWORK CHARGES EACH COMPANY $425,000 PER YEAR.

Passports to Profits

The European insurance business is divided into three distinct sectors: life, nonlife and reinsurance. Life includes savings, pensions, health insurance and normal life insurance coverage. Nonlife (property and casualty insurance in the United States) includes individual and corporate coverage for houses, cars and factories, as well as liability insurance for damage that a policyholder might cause. Reinsurance is essentially the insurance that insurance companies take out to protect themselves from claims.

Whatever the insurance sector, much remains to be done before European insurance companies can reach the goal of having a single European "passport," as the concept of being able to sell a single insurance policy in a unified market is called. They will have to simplify their products, sort out currency differentes and find new ways to distribute their wares, says Ernest Morris, group general manager for management services at The Prudential, Europe's third largest insurance company. "In the insurance business, there is a hell of a long way to go before there is a single market: 1992 is a concept, not a date. My impression is that those companies that do have operations in several countries arrange IT on a country-to-country basis," says Morris.

These companies will need to broaden their internal corporate IS strategies to include a range of business partners, asserts Bristol University's Watkins. Such industrywide IS strategies will enable insurers to capitalize on their systems by making it easier to deal electronically with external sales outlets, such as banks.

Insurance companies of all stripes are finding that networking is a more cost-effective way of reaching their sales outlets and, ultimately, customers: This is no surprise, since their highest cost, after the money they pay out in claims, is the cost of sales. In Britain, for example, each £1 a salesperson collects in commission from the company for the sale of a policy yields a measly 50 pence for the shareholders over the entire life of the policy, according to *The Economist* magazine. The U.K. alone has four networks that feature specialized services solely for retailers of life and nonlife insurance. Run by British Telecommunications PLC, Digital Equipment Corp., IBM and the AT&T-owned Istel Ltd., respectively, these value-added services pump information from U.K. insurance companies to more than 30,000 retail outlets, reducing administrative costs for the insurers. Rather than having to contact a number of insurance company employees in different departments to get information, the brokers and financial institutions that access these networks from PCs or videotex terminals can compare contracts, inspect premium rates, receive advice and exchange basic policy details using data from mainframes operated by the country's insurance companies.

Still, to get the most out of such new technologies, IS will have to do a better job of selling itself, both internally and externally, some surveys indicate. The surveys show that not all of the industry is sold on information technology. A survey carried out by Meridian Computer Services (MCS), a London-based software company serving the insurance business, found that many retailers were ignorant of the networks. Some 80% of brokers were undecided about which one to use or had not even heard of their existence, according to MCS.

□ OUR MAJOR SYSTEMS THRUST IS BETTER IT SUPPORT FOR THE SALES FORCE.

Other reports have questioned the quality of information management in

The Urge To Merge

Joining forces outside their home markets seems to be the most attractive way for Europe's insurers to acquire the investment clout they need for new IS strategies.

COMPANY	1988 PREMIUM INCOME ($ Billions)	MERGERS
Allianz (W. Germany)		
Italy	$2.10	Bought 51.5% of RAS between 1984 and 1987
Britain	$1.16	Bought 100% of Cornhill in 1986
Spain	$0.35	Signed cooperation agreement with Banco Popular in 1988. Bought 51% of Ercos in 1989 ($60 million in premium income in 1989)
France	$0.31	Bought 50% of CNM's insurance interest in 1989 ($1.4 billion in premium income in 1989)
Generali (Italy)		
France	$1.41	Bought 17% Compagnie du Midi in 1988 (owns Equity & Law of Britain and merged with Axa-Midi
W. Germany	$0.86	
Britain	$0.64	
Spain	$0.25	
UAP (France)		
Spain	$0.14	To buy Gesa in 1990
W. Germany	$0.13	Bought 34% of Groupe Victoire in 1989 (controls Colonia Group, $4 billion in premium income in 1989)
Italy	$0.12	Bought Allsecures in 1989
Britain	n/a	Bought 25% of Sun Life in 1988*
Prudential		
Italy	$0.101	Joint venture with Benetton in 1988; restructured with L'Abeille (Group Victoire) in 1990

*Current stake

Source: *The Economist*, February 1990

the insurance industry. Jeremy Dickson, a partner at Coopers & Lybrand Deloitte, a U.K. accounting firm, claims that many companies are operating 10- or 20-year-old systems and are postponing upgrades because of the time and cost involved.

But insurance company executives cannot be entirely blamed for failing to come to terms with IS, according to a second survey. A study by KPMG Peat Marwick McLintock found that an average of $6,000 was spent per employee each year on IS at the top 50 U.K. insurance companies. But "hardly any" of that money was spent on educating management about IS.

Combating Technophobia

Indeed, the trend toward end user computing has yet to result in a comparable distribution of IS skills, says Vernon Bryce, human resources group manager at Peat Marwick. "Management in insurance operates in a very traditional, hierarchical way. But IS is requiring them to manage in a different way that fits the new market requirement mentality," Bryce observes.

Management technophobia is not distributed equally throughout the insurance industry and is less of a problem in the reinsurance sector. Of the 80 companies that applied earlier this year for services from the RINET network, 45 were reinsurers, 29 were insurers and six were brokers. Xavier Dereppe, RINET's general manager, was optimistic that the service will win friends as it comes on line this year. RINET is aiming for more than 200 corporate users that will exchange electronic mail messages and transfer files via host systems or PCs.

☐ THERE'S A LONG WAY TO GO BEFORE THERE'S A SINGLE INSURANCE MARKET.

Companies in the life insurance sector, which rely on salesmanship and a competitive price to succeed, have tended to lead in IS applications. Over half the life companies in Britain, for example, have installed a myriad of new applications software in the last couple of years, well ahead of the other sectors of the industry. "The major part of our systems thrust is improving the IT support to our sales force," says Morris of The Prudential. The trend in the company is toward client-based databases; that is, databases arranged around customers' names rather than around the company's various types of policies.

The Prudential sales force works from home, using handheld machines that can upload and access the data from branch systems, Morris says. The handheld machines play a vital part in what The Prudential calls "front-room salesmanship," allowing salespeople to perform instant calculations showing potential customers the policy options open to them.

Morris sees IS supporting three key elements of the insurance business: the product, its administration and its distribution. "We are trying to make it much easier to make the changes in administration that result from changes in a product. The key thing in administration is cost reduction, which we can cope with," he explains. "But in distribution there is a certain amount of ferment: VANS [value-added network services] and EDI are causing people to look at their systems [differently]. Data communications mean you have to enter a new world in terms of system availability and screen layouts."

Image processing, too, is a key technology for the future of the insurance industry, and one that is high on the list of vendors such as IBM. Efforts to cut down on paperwork will benefit more than just the bottom line, says IBM's insurance industry director for Europe, Peter Salinson. Europe consumes 40 million trees per year just to fuel its insurance business.

IBM is also working on expert systems to aid underwriters, but its main thrust is in developing a standard set of industry data structures based on its Systems Application Architecture (SAA). The structures would allow customer data to be processed with more consistency. "One of the problems the [insurance] industry has is how to protect its investment [in client data]. Information on a customer will often be held in eight or 10 different places," says Salinson.

In Europe, the insurance industry is beginning to realize that it can no longer relegate information technology to administrative back room functions. As Salinson says: "The question is how the industry is going to attract customers and get away from their old applications and to plug in new ones." Indeed, it is clear that being able to increase market share and engender staunch customer loyalty will more and more depend on an insurer's aggressive use of IS. ▭

John Lamb is editor of Computer Weekly in Sutton, Surrey, U.K.

THE DATAMATION 100

The Year of the Notebook PC

Competitive smoke rose from most sectors of the Japanese information technology marketplace in 1989, with personal computing innovations the hottest.

BY STEVE McCLURE

Although the yen declined steadily in 1989 from a high of ¥120 to the dollar at the beginning of the year, Japanese IT suppliers relied heavily on selling their wares in the local market. In that economy driven by increasing domestic demand, the greatest amount of competitive heat was generated at the low end of the IT market as PCs and workstations invaded the traditionally paper-bound Japanese office with a vengeance.

In the next few years, competition among Japanese information technology vendors should flare up on the high end of the product spectrum, as well. The U.S.-Japan Super 301 trade agreement concluded this year, for one thing, should ensure that Japan's supercomputer vendors, Fujitsu Ltd., Hitachi Ltd. and NEC Corp., will face greater competition from U.S. vendors of supercomputing systems, such as powerhouse Cray Research Inc. In another high-end arena, a new mainframe line and operating system from Hitachi have signaled the company's intention to try to increase its share of the IBM-compatible market, both at home and in the United States.

As in many other parts of the world, systems integration emerged in 1989 in Japan as one of the fastest growing segments of the information technology market. Analysts see it as a key trend for the 1990s, with major IS suppliers poised to enter the field, following the lead of NTT Data, the only company in Japan so far to specialize in all aspects of systems integration.

The heat of domestic demand in 1989 did not fuel the top 10 vendors in Japan into growing as fast as they did in 1988. After enjoying 29% growth in 1988, Japan's top 10 companies grew 14% in 1989, from $43.6 billion to $49.7 billion, in dollar terms. When measured in yen, the growth rate was 24%, however. And once again the threshold for entry into the Japan 10 rose steeply—up 43% from Ricoh Co. Ltd.'s $1.12 billion in 1988 to Mitsubishi's $1.60 billion this year.

Fujitsu Gets Its Just Desserts

New financial information received from Fujitsu since publication of the DATAMATION 100 (in the June 15, 1990 issue) has boosted it to its usual No. 3 rank worldwide and No. 1 rank in Japan. Originally, DATAMATION's sources had estimated Fujitsu's total information systems revenues for 1989 at ¥1.57 trillion or $11.37 billion, placing the company at No. 4 in the world. The new figures put Fujitsu's sales for the year at ¥1.68 trillion, or $12.16 billion. Fujitsu's local sales, at 86% of its worldwide revenues, come to ¥1.44 trillion or $10.46 billion.

The Top 10 Suppliers in Japan

Fujitsu once again leads the top 10 vendors, which include Digital Equipment Corp. for the first time.

1989 RANK	1988 RANK	COMPANY	COUNTRY	1989 JAPAN IS REV	% CHANGE FROM 1988	1989 TOTAL IS REV	% CHANGE FROM 1988	JAPAN IS REV AS % OF TOT REV	% CHANGE FROM 1988	U.S. IS REV AS % OF TOT REV
1	1	Fujitsu	Japan	10,457.9	14.1%	12,160.4	10.6%	86.0%	2.0%*	8.0%
2	2	NEC	Japan	10,102.8	13.1%	11,480.4	9.6%	88.0%	3.0%*	6.0%
3	4	Hitachi	Japan	7,498.4	7.0%*	8,719.0	5.7%	86.0%	1.0%*	10.0%
4	3	IBM Japan	US/Japan	6,896.1	5.4%	9,513.7	2.6%	72.5%	1.4%	0.0%
5	5	Toshiba	Japan	3,951.8	11.0%	4,595.1	8.7%	86.0%	1.9%*	6.0%
6	6	Matsushita	Japan	2,931.0	9.2%	3,663.7	6.5%	80.0%	2.0%	12.0%
7	9*	NTT Data	Japan	2,254.0	33.1%	2,254.0	33.1%	100.0%	0.0%	0.0%
8	7	Nihon Unisys	Japan	2,112.7	2.7%	2,112.7	2.7%	100.0%	0.0%	0.0%
9	8*	Digital	United States	1,940.5	5.3%	12,936.7	5.3%	15.0%	0.0%	46.0%
10	11	Mitsubishi	Japan	1,600.3	6.7%	2,025.7	2.7%	79.0%	3.0%	15.0%

* Based on restated 1988 figures.
All currency figures are in millions of dollars.
Source: DATAMATION

Top Asian Achievers

Asian companies with the healthiest IS revenues

ASIAN RANK	WORLD RANK	COMPANY	TOTAL IS REVENUE ($ MILLIONS)
1	3	Fujitsu	12,160.4
2	4	NEC	11,480.4
3	6	Hitachi	8,719.0
4	13	Toshiba	4,595.1
5	14	Canon	3,783.3
6	15	Matsushita	3,663.7
7	24	NTT	2,254.0
8	25	Nihon Unisys	2,112.7
9	29	Mitsubishi	2,025.7
10	30	Oki	1,952.0
11	33	Ricoh	1,799.5
12	40	Seiko Epson	1,449.5
13	42	C. Itoh	1,345.9
14	72	CSK	520.0
15	75	Acer	493.7
16	86	Alps	420.4
17	94	Mitac	380.0
18	97	Kyocera	366.4
19	105	Sony	326.1
20	106	Nomura	322.0

No. 2 NEC Corp.'s domestic sales, which account for 88% of its worldwide sales, amounted to ¥1.40 trillion or $10.1 billion.

Meanwhile, Hitachi and IBM Japan switched places this year, with Hitachi moving up to No. 3 and IBM dropping to No. 4. Hitachi's Japanese revenues totaled $7.50 billion, up 7%. IBM Japan's domestic IS revenues were up 5.4% to $6.90 billion; its total IS revenues, which include sales to the rest of Asia, were up 2.6% to $9.51 billion. Strong sales in Japan of Toshiba Corp.'s notebook-sized computer helped boost its local IS revenues 11.0% and enabled it to keep ahead of NTT Data, which moved up from ninth to seventh place on the strength of its booming systems integration business.

Mitsubishi reentered the Japan 10 after slipping to No. 11 last year, thanks to improved earnings in the domestic market. Those earnings stemmed from Mitsubishi's concentration on the burgeoning "business computer" market, which in Japan includes any office computer that is not a mainframe.

Mitsubishi Enters at the Low End

Mitsubishi's improved status is no surprise, given that the popularity of low-end computers continues to grow by leaps and bounds as Japanese manufacturers come out with ever-smaller portables and better PC software. At the smallest end of the computing realm, Sony Corp. introduced the innovative Palmtop, a keyboardless machine that instead uses a graphics tablet under a liquid-crystal display that is activated by the touch of a stylus. Despite its information technology innovations, Sony's 1989 IS revenues were not sufficient to rank it in the Japan 10.

Last year can appropriately be called "the year of the notebook computer," as many models of these lightweight, relatively powerful devices have taken the nation by veritable fire storm. Toshiba was first out of the chute in July, releasing its Dynabook, an 8.5×11-inch, paper-sized, 16-bit machine with a liquid crystal display screen. The machine weighs in at 2.7 kilograms and sells for about $1,200. The Dynabook's compact size and low price stunned the industry, and by the end of the year, Toshiba had sold 120,000 units. Soon a host of competitors entered the market: IBM joined the fray in October with its IBM 5449 Online Note, NEC introduced its 98 Note in November and this year Seiko Epson Corp. and Ricoh both started marketing their own 16-bit notebook computers.

Laptops were another highlight of the Japanese IS market in 1989. NEC introduced a color laptop, the 16-bit PC-9001LX5C, which has a price tag of roughly $4,800. So far in 1990, Toshiba has unveiled the SPARC LT, a laptop UNIX engineering workstation, and Sony has followed suit with a similar model.

Although UNIX has attracted the attention and investments of every major Japanese computer supplier, there is no more agreement in Japan as to which version of UNIX is best than there is in the U.S. market. An attempt to unite the two rival versions of the UNIX operating system came to grief in May this year, as Hitachi endorsed the IBM-backed Open Software Foundation version of UNIX, while NEC, Fujitsu and Toshiba chose to go the UNIX International route.

Some analysts say that resolving the issue is of little importance to users. Many analysts are not sure that standardizing on a single version of UNIX is even necessary if the look and feel of the application is the same regardless which operating system is running, says Junichi Saeki, information system group research manager for Dataquest Japan. He adds that he expects the overall UNIX market to grow more rapidly after 1991, as more compact workstations come onto the market and increased demand for networking capability pushes MS-DOS out of the picture.

NEC Owns the PC Market

For now, NEC continues to dominate the PC market with strong sales of its 16-bit PC-9800 and its 32-bit PC, thanks to its huge array of supporting software. In an attempt to counter NEC's dominance of the PC market, 10 companies joined forces last year to develop their own Japanese-language software for 32-bit machines.

It is no coincidence that these 10 vendors are cooperating since more than 50,000 workstations were sold in Japan in 1989, compared with approximately 100,000 units sold over the previous four or five years. Financial, manufacturing and engineering firms are using them on an ever-increasing basis as their prices decline; the quality of their graphics increases and Japanese-language models become available.

% CHANGE FROM 1988	NET INCOME	1989 EMPLOYEES
-2.0%	623.1	95,000
-2.0%	518.9	116,890
-1.0%	1,463.3	290,000
0.0%	739.5	23,019
0.0%*	935.0	142,000
-1.0%	1,570.1	193,088
0.0%	23.5	7,000
0.0%	34.1	8,181
-2.0%	875.8	125,900
-5.0%	488.5	89,500

Matsushita Electric Industrial Co. Ltd., which reentered the PC and workstation market last year after leaving in 1987, is one company that expects the workstation sector to grow up until the mid-1990s. So is Sony, which has placed high hopes on its NEWS series, despite suffering a setback when sales of its PopNEWS model were lower than anticipated because of a lack of appropriate software.

Desktop Revolution

Analysts say further improvements in workstation screen resolution finally could bring the desktop-publishing revolution to Japan. "There is a huge market," says Dataquest's Saeki. "Around Tokyo there are 50,000 small printing companies." Such companies still generally use old-fashioned metal type, which makes printing with the myriad of Japanese characters a daunting task.

As PCs continue to be upgraded and workstations become cheaper and easier to use, maintaining a distinction between the two groups is becoming irrelevant in Japan as elsewhere in the world, analysts say. Top officials at Japanese computer firms, according to a recent *Nikkei Computer* magazine survey, see the market eventually splitting into two main groups of machines: high-performance mainframes controlling expanded networks and database systems, and a group of machines that could be termed "advanced personal computers."

☐ THE TRADE PACT COULD MEAN MORE COMPETITION IN SUPERCOMPUTERS.

Fujitsu's bold attempt in 1989 to introduce one such advanced PC, the 32-bit FM Towns, met with mixed success. Aiming at both the home and business markets, the firm wound up making a hit with neither, largely due to the lack of appropriate software. The computer's price—about $2,600—was well out of the standard home PC range. But the FM Towns' main selling point—its use of software based on compact disc read only memory (CD-ROM) technology—gives it good graphics and huge data storage capabilities. Sales have picked up since its lackluster 1989 launch, as more software has become available.

Making the Japanese market available to non-Japanese supercomputers was one main objective of the recent successful round of trade talks between the U.S and Japan. The market-liberalizing Super 301 agreement concluded in March is supposed to help foreign computer makers by prohibiting what amounts to dumping by Japanese manufacturers, which had been selling supercomputers at very high discounts to Japanese public institutions.

Hitachi's Main Moves

On the mainframe front, Hitachi made moves seemingly aimed at IBM. Hitachi claims its M-800 Processor Group, introduced this spring, is now the world's fastest mainframe, at 155 million instructions per second (MIPS). Analysts believe Hitachi is serious about trying to increase its market share in the United States, where it now has about 7% of the IBM-compatible mainframe market. Many also see it as a challenge to IBM, whose lead Hitachi has followed until now.

Some industry sources expect mainframe-processing speeds to improve to the range of 200 to 400 MIPS during the 1990s. Future generations of mainframes also could sport great improvements in parallel processing, if the government has its way. In a report issued earlier this year on its Fifth Generation project, the Japanese government discussed the possibility of developing computers with millions of parallel processors.

Building systems that can cope with such new technologies is part of the reason systems integration will be important in Japan through the coming decade.

To meet this need, Japanese systems vendors are steadily placing more emphasis on software, an area in which they traditionally have been weak. Companies such as NTT Data, Japan's leading systems integration specialist, are setting up their own software development subsidiaries. One estimate is that software and related services will account for 50% of all IS sales in Japan by the end of the decade.

Dataquest's Saeki says it will take a few years for Japanese systems suppliers to refine their systems integration skills. Even NTT Data, for instance, still has a long way to go, says Saeki. "NTT Data doesn't have enough experience to be a true systems integrator at present," he says. "But the potential is there. They are in a good position to be the first systems integrator in Japan, but they need at least two years in which to get the necessary experience." NTT's strength, Saeki adds, is its large pool of talented employees, solid capital base and many government and private sector contracts.

Suppliers Take the Plunge

Other observers expect more systems suppliers to plunge into the SI market by forming consortia with companies in specific industries. Their hope is to offer large-scale SI services designed to solve interrelated office or factory information problems in a centralized way. The need to solve those problems is also expected to increase demand in the '90s for broadband Integrated Services Digital Networks (ISDN); fiber optic-based local area networks with transmission speeds of several gigabits per second; and ISDN-like networks supporting simultaneous transmission of images, voice and data.

The pervasiveness of advanced communications and the proliferation of PCs and workstations in Japan should ensure that growth in the IS industry does not cool down. Indeed, the authoritative *Nikkei Computer* magazine predicts a rate of 12 to 13% overall annual growth until the middle of the decade. That growth, however, depends on the ability of Japanese companies to keep making hardware innovations while improving their expertise in fast-growing fields like systems integration and software. ▭

Steve McClure is a freelance writer based in Tokyo.

What's Hot in Japan

Top Japanese PC suppliers

	COMPANY	PC REV	TOTAL IS REV
1	NEC	3,116.5	11,480.4
2	Toshiba	1,340.8	4,595.1
3	Fujitsu	869.7	12,160.4
4	Hitachi	652.3	8,719.0
5	Seiko Epson	579.8	1,449.5

Top Japanese service suppliers

	COMPANY	SERVICE REV	TOTAL IS REV
1	NTT	898.7	2,254.0
2	NEC	289.9	11,480.4
3	Fujitsu	253.7	12,160.4
4	Hitachi	181.2	8,719.0
5	C. Itoh	108.7	1,345.9

Revenue figures are in millions of dollars.

Economic Weakness Takes Its Toll on IS

Take one part competition, another part world economic slowdown and the result is a potion that has given many an IS vendor sleepless nights while IS execs sleep like babes.

MADELINE FRANCHI

What may be giving suppliers of information technology a case of insomnia is helping many IS executives sleep better at night.

After the intoxication of double-digit growth in much of the 1980s, IS vendors the world over woke up at the end of the decade with something of a hangover, staring glumly at the prospect of less than 6% growth.

But this decline in revenues does not really represent a drop in user demand for computing. Rather, it carries evidence of a trend already familiar to and welcomed by IS execs: increasingly greater performance for less money.

Figures from the DATAMATION 100 (June 15, 1990) show that data-processing revenues from the top 100 companies worldwide rose just 5.5% in 1989, after double-digit gains in the prior four years.

Figures from the Commerce Department confirm the DATAMATION 100's evidence of slowing growth for U.S. vendors. U.S. factory shipments of computers and office machinery eked out growth of only 2.9% in 1989, representing the lowest annual gain since the 5.6% decline recorded in 1986.

But slowing sales for U.S. vendors do not translate into a dearth of hardware entering into U.S. businesses. In inflation-adjusted (or constant) dollars, U.S. purchases of computer hardware grew 11% in 1989. And in the first quarter of this year, domestic investment in this equipment rose at an annual rate of 8.2% to reach an annualized, inflation-adjusted total of $134 billion.

Furthermore, a look at purchases in current-dollar terms reveals the increasing bang for the buck that U.S. companies are enjoying. In 1989, U.S. purchases of mainframes, minis, micros and peripherals, when counted in current dollars, advanced just 4.2%—less than half as much as the constant dollar measure. In 1990's first quarter, the annual rate measured an even weaker 3.5%, a relatively low yearly growth by historical standards.

Growth rates in current dollars can only be lower than growth rates in constant dollars over the same time frame if prices are deflating. According to the Commerce Department, the price of computing power has dropped about 43% just from the beginning of 1985 to the first quarter of 1990. So the computer processing that cost $1 five years ago, now costs only 57 cents.

Cahners Economics predicts U.S. companies will increase their purchases of computer hardware and peripherals by only about 3.4% (in current dollars) for all of 1990 but will bounce back and purchase a relatively hefty 8% in 1991.

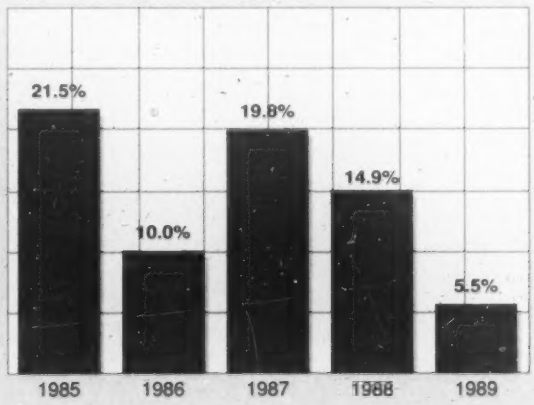
As a share of data-processing revenue of the top 100 user companies, software revenue is on the rise. From 6.3% of IS revenues in 1985, software accounted for 9.6% of the pie in 1989. Similarly, the share of revenue from services has jumped from 6.8% in 1985 to 8.8% last year. Put your money on this upward trend continuing for some time. ▭

For more information on Cahners Economics' forecasting services, including seminars, newsletters and database diskettes, contact Dan Buchan at (617)-558-4758 or (617)-964-3030, or write Cahners Economics, 275 Washington St., Newton, MA 02158.

The IS Market Shrinks...

IS executives don't have to spend as much as they used to for the processing power they need.

WORLDWIDE IS REVENUE GROWTH

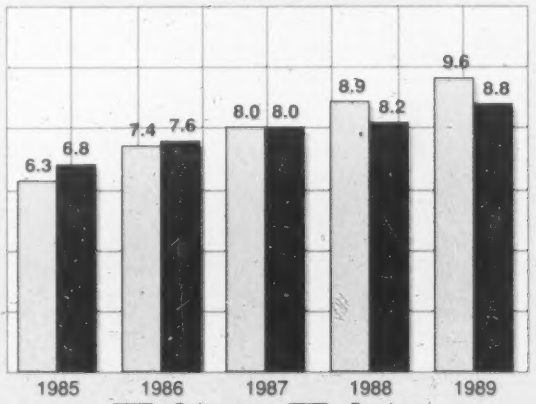


Source: DATAMATION 100

But the Software Slice Grows

Vendors are finding their market is changing from one driven by innovations in hardware to one spurred by solutions based on software and services.

SOFTWARE AND SERVICES REVENUE AS A SHARE OF TOTAL IS REVENUE



Source: DATAMATION 100